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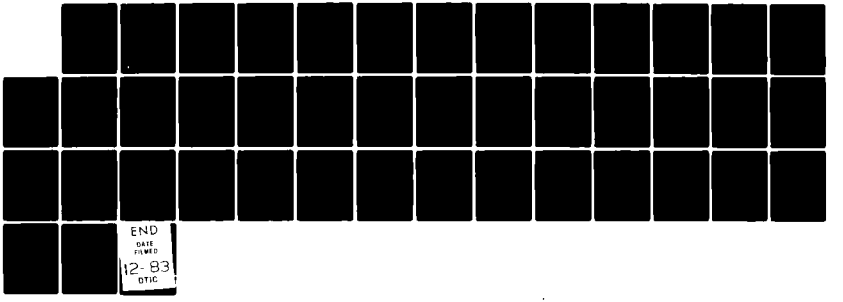

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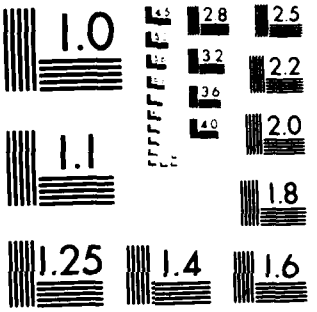

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FINAL TECHNICAL REPORT

FOR

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

AIR FORCE SYSTEMS COMMAND, U. S. AIR FORCE

Contract No. F49620-78-C-0009

1 October 1977 - 15 May 1983

FILM SYNTHESIS AND NEW SUPERCONDUCTORS

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G. L. Report 3566

May 1983

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Date Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER AFOSR-TR- 83-0907 2. GOVT ACCESSION NO. AD-A135 [illegible]	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) FILM SYNTHESIS AND NEW SUPERCONDUCTORS	5. TYPE OF REPORT & PERIOD COVERED FINAL TECHNICAL REPORT 1 Oct. 77 - 15 May 83
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Department of ~~Applied~~ Physics Stanford University Stanford, California 94305 Author: T. H. Geballe	8. CONTRACT OR GRANT NUMBER(s) F49620-78-C-0009
9. PERFORMING ORGANIZATION NAME AND ADDRESS Air Force Office of Scientific Research/NE Bolling AFB, Washington, D.C. 20332	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 2506/C1 PE61102F
11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE May 1983
	13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Superconductivity	Heat capacity
Vapor deposition	Thin films
Electron-phonon interaction	Amorphous metals
Metastable phases	Multilayers
A15 structures	Superconducting tunneling

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This research has been concerned with films that are metastable compounds or multilayered composites which are quenched from the vapor phase. They have been stabilized by a number of methods which aid in the quench or by growing upon especially prepared surfaces upon which epitaxial growth can take place. The occurrence of superconductivity in the metastable films has been investigated. Newly developed

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE S/N 0102-LF-014-6601

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methods of heat capacity and tunneling techniques have been used to study the superconducting interactions and to provide the increased understanding of the mechanisms of superconductivity necessary to reach higher transition temperatures.

FINAL TECHNICAL REPORT

The objectives of the research given in the statements of work appearing in the contract have been addressed and the results have been published in the archival literature as listed in Section II. They have also been discussed in talks given at meetings and symposia as listed. The following items summarize the work which has been accomplished.

1. The phase boundaries of the binary A15 superconductors Nb_3Si, Nb_3Al and Nb_3Ge and related three-component compounds obtained by chemical substitution have been extended by optimization of the growth parameters.

Nb_3Al thin films have been prepared and characterized with varying deposition parameters, including substrate temperature, deposition rate, gas doping, and epitaxial growth. Nb-Al samples made with the optimum substrate temperature have lattice constants following the prediction of Geller radii and a systematic T_c increment with Al composition, namely, a $\Delta T_c/\Delta C$ of 1.9 K/at.% Al. Employment of the self-epitaxial method results in extending the A15 phase boundary by 1 at.% Al and an enhancement of T_c by 2.4 K at a given substrate temperature.

Stoichiometric Nb_3Ge films have been synthesized and the relationship between superconductivity and long range order has been studied. The superconducting properties of Nb_3Ge and their relationship to normal state properties has been investigated using newly developed calorimetric and tunneling techniques.

The synthesis of high-T_c A15 Nb_3Ge without epitaxy has been found to require the addition to 0_2 during growth. Without the 0_2 , the bulk phase equilibrium is found with a T_c = 6 K. However, Auger profiles of the high-T_c 0_2-doped specimens show very little 0_2. Experiments suggest that the 0_2 is present in the Nb_3Ge at 900 C at concentrations of 1-2 at.%, but that essentially all the 0_2 has left by the time the specimen has cooled to 500 C. The homogeneity range of the A15 structure of niobium-germanium was extended up to 26 percent germanium as compared to the thermodynamic equilibrium boundary at 19 percent.

More homogeneous films of high T_c Nb_3Ge have been prepared as demonstrated by a total transition width of less than 1 K and a resistive T_c onset of 21.7 K. X-ray diffraction analysis done both at Stanford and at Westinghouse shows no evidence of a second phase to the limits of the instruments (< 1%). Tunneling as a function of thickness shows the material to be of good quality at the surface for thicknesses of up to 1 μm. Further evidence of homogeneity is demonstrated by critical current measurements which give an extrapolated T_c^* of 20 K on material with resistive T_c onset of 21.9 K.

The conditions under which niobium-silicon can be formed in the A15 crystal structure with optimal superconducting transition temperature have been investigated. The combined effects of vapor phase quenching and compositionally modulated epitaxial growth of films have been employed with some success.

Films of Nb-Si with the metastable A15 structure have been grown epitaxially on polycrystalline Nb-Ir. Following the initial epitaxial deposition in which the composition has been made Nb-rich in order to match lattice parameters, the ideal Nb_3Si stoichiometry is approached by a compositional grading technique i.e., by gradually decreasing the Nb concentration during the subsequent growth. Compositional grading has enhanced T_c by more than 6 K, up to an onset of 13.2 K. The best results are obtained when the initial epitaxy is such that Nb-Ir lattice expands the Nb-Si over-growth slightly beyond its own natural lattice parameter. Experiments using transmission electron microscopy have shown that the ability of composition grading to bring the A15 phase toward the 3:1 stoichiometry is limited by the growth of silicon-rich phases in the A15 grain boundaries. Oxygen has been found to suppress the growth of the unwanted silicon-rich phases by slowing down grain boundary diffusion.

The univerality of the T_c of Nb_3Sn-based films as a function of resistivity has been explored. The high-temperature roll-off is found to vary from 20 to 40 $\mu\Omega$-cm depending upon the annealing treatment and substitution of Ga for Sn.

The ternary electrical $Nb_3(AlGe)$ system has been studied in order to determine its applicability for use with liquid hydrogen as a refrigerant. The previously reported increase in the compositional range in the A15 phase towards stoichiometry

does exist, however it is retrograde with temperature (similar to the behavior found in both Nb_3Al and Nb_3Ge).

Phase diagrams for Mo-based A15 compounds at temperatures below 1000 K (where conventional techniques become unreliable) have been explored by the use of atomic and molecular beam codeposition techniques.

The pseudo-binary system Nb-Mo-Si has been investigated. The A15 phase has been extended from stable Mo_3Si 90% of the way towards the unstable Nb_3Si. The Si-rich phase boundary was found to decrease rapidly over a narrow range of increasing Nb concentration from 16 at.% Si to 18 at.% Si. The superconducting transition temperature shows a modest peak up to 4.6 K in the corresponding region of the phase diagram.

2. The effects of laser annealing of deposited films at selected temperatures has been explored.

Laser annealing using the continuously-scanned technique of Professor J. Gibbons has been applied to the synthesis of the metastable A15 superconductors. It has been found that disordered or amorphous films can be heated for short times to high temperatures without decomposition. Compositions of Nb_3Al corresponding to the maximum Al concentration at the peritectic temperature can be quenched to room temperature. For the Nb-Si system a single phase-non-stoichiometric A15 structure can be formed from the amorphous phase.

Ordering of disordered Nb_3Sn starts to occur after a single laser scan, making possible an estimation of the activation energy for ordering at high temperatures (1000-2000°C) for times < 0.1 sec. In contrast, laser annealing of well-ordered high T_c Nb_3Sn and V_3Si is found to alter both the resistivity and the T_c . Metastable high T_c Nb_3Ge shows a marked non-monotonic dependence upon annealing temperature which is believed to arise from the formation of a low T_c phase at intermediate annealing temperatures.

3. The methods of superconducting tunneling and low temperature heat capacity measurements have been employed to investigate the homogeneity of newly synthesized films, their superconducting parameters, and the mechanisms responsible for unusual superconductivity. Microscopic parameters derived from tunneling experiments have been compared with heat capacity measurements on the same film or similar films.

High quality A15 NbGe/SiO_xPb tunnel junctions on electron beam codeposited oxygen-doped Nb_3Ge have been fabricated. The ratio of the superconducting energy gap to the transition temperature is found to rise from the BCS limit in Ge-poor samples and to become strong coupled ($2\Delta/k_BT_c \sim 4.35$) as stoichiometry is approached. These junctions were found to have satisfactory features for taking derivative measurements. The data were reduced by the modified McMillan-Rowell proximity gap inversion analysis developed by Arnold and Wolf to generate

$\alpha^2F(\omega)$ and related microscopic parameters. As the T_c and gap increase, a movement of the lowest phonon branch to lower energies is observed. Mode softening is a major factor in the increase of T_c with approach to stoichiometry.

Single particle (Giaever) tunneling has been performed on A15 Nb_3Al thin films with good-quality junctions formed by oxidized amorphous-silicon barriers. The electron-phonon spectral function $\alpha^2F(\omega)$ and related physical parameters were generated by inversion analysis of the experimental tunneling density of states. The results show that Nb_3Al is a strong-coupled superconductor with $2\Delta/k_BT_c \geq 4.4$ when the composition approaches the A15 phase boundary (23 at.% Al). The low frequency behavior of $\alpha^2F(\omega)$, observed between two junctions of different coupling strength, strongly suggests the importance of a mode softening mechanism, and implies that the average $\langle\omega\rangle$'s are rather sensitive to composition.

4. Superconducting films have been characterized by spectroscopic and sputter profiling techniques. Transmission electron microscopy has been used to characterize the microstructure of A15 superconducting films using bright field, dark field, lattice imaging, and electron diffraction.

Extended X-ray Absorption Fine Structure (EXAFS) spectroscopy has been carried out on the Ge K-edge in Nb_3Ge with the A15 structure. Films with samples prepared by the CVD and e-beam coevaporation techniques and having different superconducting

transition temperatures. For the e-beam samples, our EXAFS experiments confirm the existence of two phases, one of which is quasi-amorphous with smaller atomic separations and average coordination number than the A15 phase. No evidence of any lattice transofrmation between 77 and 573 K was obtained. The additional temperature dependence of the fluctuations in the nearest neighbor and other distances agrees with expectations from the phonon spectrum determined by neutron scattering.

The microstructure and growth morphology of electron-beam deposited Nb_3Sn is changed drastically by the co-evaporation of copper. The main parameters that affect the resulting microstructure of the Nb_3Sn are the Cu:Nb_3Sn ratio, the total deposition rate and the substrate temperature. The microstructure of the Nb_3Sn-Cu composite ranges from a two-phase mixture of equiaxed grains of the same diameter (180 Å) in one case to long narrow rods enclosed by the copper phase in another case. The superconducting transition temperatures are changed only slightly over the range 0-92 at.% Cu. The variety of very-small-grained microstructure configurations obtained show promise of unique mechanical and superconducting properties.

The correlation between the deposition parameters, including rate, substrate temperature and chemical composition, and the microstructural features of both pure Nb_3Sn and coevaporated Nb_3Sn-Al_2O_3 films has been studied using transmission electron

microscopy as the main tool. The corresponding superconducting properties have been characterized by measurements of the critical temperature, the residual resistivity and the initial slope of the upper critical magnetic field. Pure Nb_3Sn films grow as fibers or columns with diameters from 250 Å to 2000 Å. Coevaporation of Al_2O_3 causes a refined, stabilized and equiaxed growth morphology and also an extremely fine distribution of intragranular voids 25 Å in diameter. The critical temperatu·· is not degraded by the Al_2O_3 .

5. The effects of small scale microstructure on the strengt of the pinning force, and on the deformation properties of selected superconductors have been explored. In particular, attempt to determine the parameters that limit the pinning force over various regions of magnetic field.

The critical current has been measured as a function of magnetic field for films of niobium tin prepared with a variety of microstructures. The peak in the pinning force depends inversely upon grain size down to dimensions of four hundred angstroms. A decrease in pinning force found for smaller dimensions limits the maximjm critical current to values lower than are theoretically expected. The codeposition of copper with the niobium tin decreases the superconducting transition in an unexpectedly large way in the niobium-rich A15 compounds suggesting it is possible in some circumstances to substitute copper into the A15 lattice.

The electron scattering mechanism has been used to calculate the elementary pinning force at a grain boundary in A15 phases of Nb_3Sn, V_3Si, Nb_3Ge, and Nb_3(Sn Ga) and Nb_3Sn-Al_2O_3 composites. A direct summation of the elementary pinning force of each boundary has been compared with the experimental results. Except for the Nb_3Ge, the calculations and experiments show a similar temperature dependence for the pinning force which, unlike that predicted by any other mechanism, is different for the clean and dirty samples. Groups of Nb-Sn samples which have the same grain size but different resistivities show the predicted maximum in the pinning force between the clean and dirty limits which shifts toward cleaner samples as the temperature increases. The magnitude of the measured pinning force equals the calculated value if the actual grain size is replaced by an effective grain size 3 to 4 times larger. It is clear from these results that pin-breaking rather than a plastic shearing of the vortex lattice defines the limit to the critical current in the A15 compounds.

6. New compounds and composites have been synthesized. A search for compounds which have unusual atomic structure of bonding which can give rise to superconductivity has been carried out.

Multilayered films of Nb-Zr have been prepared by magnetron sputtering, characterized by X-ray diffraction and X-ray

absorbtion fine structure measurements, and the coherency has been established. The superconducting transition temperatures of the composite film have been related to the compositional modulation.

The question of coherent interfaces between multilayers of sputtered Nb and Cu has been addressed using X-ray scattering. It has been found that the interfaces are not coherent and the NbCu multilayers are composed of columns strongly layered along the growth direction. The heights of the columns is about 5 times the modulation wavelength Λ. The resistivity increases monotonically with Λ^{-1} reaching 72.6 $\mu\Omega$-cm for Λ = 18.3 Å. The superconducting transition temperatures are all below 4.2 K.

Superconductivity was discovered in the ternary intermetallics $YbPd_2Ge_2$, $LaPd_2Ge_2$, and $LaPt_2Ge_2$. Superconductivity onset temperatures are 1.17 K, 1.12 K and 0.55 K respectively. Superconductivity was absent in $YBCu_2Ge_2$ and also in some well-prepared polycrystalline $CeCu_2Si$ down to 0.47 K; the latter in contrast to previously published work.

Anomalous properties of cuprous chloride under pressure were investigated. The electrical conductivity was found to decrease by many orders of magnitude above 40 kilobars and to have a surprisingly low activation energy. Rapid temperature changes of the sample at moderately high pressures produced a transient first order phase change near 200 Kelvin. The transformed sample gave a strong diamagnetic response to an imposed

low frequency alternating field which if due to conventional eddy current shielding required the transformed sample to have an electrical conductivity much greater than copper. A model invoking a new type of interfacial superconductivity has been suggested as one possible explanation of the observations.

7. The occurence of superconductivity in amorphous transition-metal-based systems has been studied.

The properties of a thin > 7000 Å film of amorphous Mo-Ge have been measured through the superconducting transition temperature using newly developed calorimetric techniques. The film is evaporated directly upon a processed silicon-on-sapphire chip which essentially is the calorimeter. The relaxation method which is employed has been extended so that it can be used for samples which have poor thermal conductances or time dependent specific heats. This makes it possible to study filaments and wires as well as films with internal time constants for heat flow ranging from a few miliseconds to several seconds.

Tunneling experiments have been carried out on thin films of amorphous Mo and Nb quench condensed on helium temperature substrates stabilized with nitrogen. The data were analyzed by several methods to obtain the Eliashberg function, $\alpha^2F(\omega)$. The resulting spectra are qualitatively different from $\alpha^2F(\omega)$ of amorphous simple metals, and in good agreement with the computer model simulation of Rehr and Alben

of the phonon spectrum of amorphous transition mtelas. Amorphous Mo-based amorphous alloys have been prepared by magnetron sputtering and electron beam evaporation and the region of metastability has been mapped out. T_c is found to decrease as the Mo concentration decreases.

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57. "CW Laser Annealing of A15 Superconductors," by B. Pannetier, T. H. Geballe, R. H. Hammond and J. F. Gibbons, Physica 107B, 471 (1981).

58. "A Silicon On Sapphire Thermometer For Small Low Temperature Calirmetry," by S. E. Early, F. Hellman, J. Marshall and T. H. Geballe, Physica 107B, 327 (1981).

59. "Research Opportunities in New Energy-Related Materials," by John L. Warren and T. H. Geballe, Materials Science and Engineering, 50, 149 (1981).

60. "X-ray Scattering From Multilayers of NbCu," by W. P. Lowe, T. W. Barbee, Jr., T. H. Geballe and D. B. McWhan, Phys. Rev. B 24, 6193 (1981).

61. "Tunneling $\alpha^2F(\omega)$ as a Function of Composition in A15 NbGe," by K. E. Kihlstrom and T. H. Geballe, Phys. Rev. B. 24, 6193 (1981).

62. "Effect of N_2H_4 Intercalation on the Transition Temperature and Electron Transport in Anisotropic Superconductor: $TaSe_3$," by K. Yamaya, T. H. Geballe, J. V. Acrivos and J. Code, Physica 105B, 444 (1981).

63. "Growth of A15 Nb-Si By Epitaxy and Composition Grading," by R. D. Feldman, Thin Solid Films, 87, 243 (1982).

64. "This Golden Age of Solid State Physics," by T. H. Geballe, Physics Today 34, 132 (November 1981).

65. "Vapor-Deposited Metastable Superconductors," by T. H. Geballe and J. Rowell, Thin Film Solids 91, 33 (1982).

66. "EXAFS Investigation of Nb_3Ge Films," by T. Claeson, J. B. Boyce and T. H. Geballe, Phys. Rev. B 25, 6666 (1982).

67. "Superconductivity in Amorphous MoGe Alloys," by W. L. Carter, T. W. Barbee, Jr. and T. H. Geballe, Bull. Am. Phys. Soc. 27, 20 (1982).

68. "Heat Capacity of Thin Film Amorphous Mo_3Ge," by J. Mattox, W. L. Carter and T. H. Geballe, Bull. Am. Physo Soc. 27, 20 (1982).

69. "Limits of Superconductivity," by T. H. Geballe, submitted to the proceedings of the 3rd Winter Meeting on Low Temperature Physics, Hacienda Cocoyoc, Mexico, (January 1982).

70. "Growth Morphology of Superconducting Nb-Si: The Effects of Oxygen and Substrate Temperature," by R. D. Feldman and B. E. Jacobson, Journal of Low Temperature Physics, 48, 477 (1982).

71. "Structure and Superconductivity of NbZr Multilayers," by W. P. Lowe and T. H. Geballe, Bull. Am. Phys. Soc. 27, 216 (1982).

72. "The Temperature Dependence of Fluxoid Pinning in A15 Materials," by J. Talvacchio, T. H. Hammond, K. E. Kihlstrom and T. H. Geballe, Bull. Am. Phys. Soc. 27, 195 (1982).

73. "Tunneling $\alpha^2F(\omega)$ on High T_c Nb_3Ge," by K. E. Kihlstrom and T. H. Geballe, Bull. Am. Phys. Soc. 27, 348 (1982).

74. "Deposition Techniques to Produce Uniform A15 Superconducting Films," by D. A. Rudman, F. Hellman and R. H. Hammond, Bull. Am. Phys. Soc. 27, 196 (1982).

75. "Specific Heat Studies of the A15 Nb-Sn System," by F. Hellman, D. A. Rudman, S. R. Early and T. H. Geballe, Bull. Am. Phys. Soc. 27, 347 (1982).

76. "Effect of Growth Morphology on Superconductive Tunneling into A15 Alloy Films, by C. C. Tsuei, S. Bending, M. R. Beasley, R. H. Hammond and T. H. Geballe, Bull. Am. Phys. Soc. 27, 196 (1982).

77. "Tunneling Characterisitcs and Related Properties of Molybdenum-Based Amorphous Films," by W. L. Carter, Bull. Am. Phys. Soc. 27, 263 (1982).

78. "Variable Oxygen Doping as a Function of Thickness in Thin Film Nb_3Ge," by K. E. Kihlstrom, K. E. Clements, R. H. Hammond, T. H. Geballe and Victor Rehn, Bull. Am. Phys. Soc. 27, 20 (1982).

79. "Novel Superconducting Materials and Mechanisms," by Marvin L. Cohen and T. H. Geballe, Superconductivity in d- and f-Band Metals 1982, Eds. W. Buckel and W. Weber pg. 619.

80. "Preparation, Tunneling, Resistivity and Critical Current Measurements On Homogeneous High-T_c A15 Nb_3Ge Thin Films," by K. E. Kihlstrom, R. H. Hammond, J. Talvacchio, T. H. Geballe, A. K. Greene, Victor Rehn, Journal of Applied Physics, 53, 8907 (1982).

T. H. Geballe (TALKS)

1. "Superconductivity in Transition Metals," by T. H. Geballe, presented at General Motors Research Labs, Warren, Michigan, November 1977.

2. "Instabilities in High-T_c Superconductors," by T. H. Geballe, presented at the 1978 Mid-Winter Solid State Research Conference, Laguna Beach, January 1978.

3. "Instabilities in High Transition Temperature Superconductors," by T. H. Geballe, presented at IBM Watson Research Center, February 17, 1978.

4. "Evolving-Superconducting Technology Some Cool Solutions to Hot Problems," Sigma Xi - Skilling Auditorium, Stanford University, January 1978.

5. "Transient Superconductivity in CuCl Under Pressure," by T. H. Geballe, presented at San Jose State, December 5, 1978.

6. "Transient Superconductivity In CuCl Under Pressure, by T. H. Geballe, presented at the University of Illinois, January 26, 1979.

7. "Transient Superconductivity In CuCl Under Pressure," by T. H. Geballe, presented at the University of Chicago, February 27, 1979.

8. "Transient Superconductivity In CuCl Under Pressure," by T. H. Geballe, presented at the University of Pennsylvania, March 5, 1979.

9. "Transient Superconductivity In CuCl Under Pressure," by T. H. Geballe, presented at Exxon Research, March 6, 1979.

10. "Unstable Superconductors," by T. H. Geballe, presented at University of California, San Diego, April 18, 1979.

11. "d- and f-Band Superconductivity - Some Experimental Aspects," by T. H. Geballe, presented at the Conference on Superconductivity in d- and f-Band Metals, La Jolla, California, June 21-23, 1979.

12. "Superconductivity at High Temperatures," by T. H. Geballe, presented at Eastman Kodak Company, July 13, 1979.

T. H. Geballe (TALKS cont.)

13. "Panel Report on Novel Materials," Meeting of the Council on Materials Science, DOE, Germantown, Maryland, October 30, 1979.

14. "High Temperature On Strong Coupled Superconductors," by T. H. Geballe, presented at Texas Instruments, Dallas, Texas, December 6, 1979.

15. "Some Theoretical, Experimental, and Applied Aspects of Strongly-Coupled Superconductors," by T. H. Geballe, invited speaker for the 1980 Annual Meeting of the American Physical Society, Chicago, Illinois, January 21-24, 1980.

16. "High Temperature Superconductors; Theory and Practice," by T. H. Geballe, presented at the Materials Science Department Colloquium, Stanford University February 1, 1980.

17. "Superconductors Their Existence and Use," by T. H. Geballe, Public Lecture at Sonoma State University, April 14, 1980.

18. "New Materials to Interest Crystal Growers," Fifth Conference on Crystal Growth, Stanford Sierra Camp, Fallen Leaf Lake, Lake Tahoe, May 14-16, 1980.

19. "Stabilization and Strong Coupling Properties of High Transition Temperature Superconductors," by T. H. Geballe, presented at the 1980 TMS-AIME Fall Meeting, Pittsburgh, Pennsylvania, October 5-9, 1980.

20. "Metastability and Superconductivity," by T. H. Geballe, presented at University of California, Santa Barbara, January 20, 1981.

21. "What Makes Superconductors Have High Transition Temperatures," by T. H. Geballe, presented at MIT, March 30, 1981.

22. "Superconducting Instabilities," by T. H. Geballe, presented at the University of Virginia, April 3, 1981.

23. "Metal-Insulator Transition," by T. H. Geballe, presented at Caltech, April 28, 1981.

24. "Thin Film Superconductors," by T. H. Geballe, presented at Westinghouse Research & Development Center, Pittsburgh, Pennsylvania, December 17, 1981.

25. "Limits of Superconductivity," by T. H. Geballe, presented at the 3rd Winter Meeting on Low Temperature Physics, in Hacienda Cocoyoc, Morelas, Mexico, January 13-15, 1982.

26. "Empirical Approach to Superconductivity," by T. H. Geballe, presented at the International School of Low Temperature Physics, 3rd Course: Advances in Superconductivity, NATO Advanced Study Institute, July 3-15, 1982, Erice, Sicily

27. General presentation at the National Academy of Sciences for high level scientific managers on opportunities in the near term on material science based on a briefing to Dr. George A. Keyworth, Science Advisor to the President and Director of the White House Office of Science and Technology Policy (OSTP). November 17, 18, 1982, The White House, December 17, 1982, NAS.

28. "Opportunities in Materials Research," by T. H. Geballe, presented at Xerox, Palo Alto, January 7, 1983.

29. "Frontiers and Limits of Superconductivity," by T. H. Geballe, presented at the University of Houston, February 21, 1983.

30. "What Have the Theorists Done for Us Lately," by T. H. Geballe, presented at the Institute for Theoretical Physics, University of Santa Barbara, California, March 18, 1983.

VISITORS AND SEMINARS

1. Professor David Goodstein, Department of Physics, Caltech
   "Ions at Phase Transitions - or Physics Italian Style"
   October 20, 1977

2. Professor Peter Wolff, Department of Physics, MIT
   "Dielectric Theory of Chemical Bonding"
   November 3, 1977

3. Dr. Shlomo Alexander, The Hebrew University, Jerusalem
   "Growth of Lamellar Structures in Supercooled Solutions"
   November 10, 1977

4. Dr. W. L. McLean, Department of Physics, Rutgers University
   "Hopping Conduction and Superconductivity in Granular Aluminum"
   December 1, 1977

5. Dr. Douglas Mills, Department of Physics, UC Calif., Irvine
   "Light Scattering From Thin Semiconducting Films: Theory and Experiment"
   December 8, 1977

6. Dr. W. L. Johnson, Department of Physics, Caltech, Pasadena
   "Electronic Structures and Stability of Amorphous Transition Metals and Their Alloys"
   December 15, 1977

7. Dr. David Emin, Sandia Laboratories
   "Theory of the Hall Effect: Application to Amorphous Semiconductors"
   January 12, 1978

8. Dr. A. Thompson, Exxon Research Laboratory
   "Lithium Ordering in Li_xTiS_2 and the $LiTiS_2$ Battery"
   January 19, 1978

9. Dr. Erio Tosatti, Istituto di Fisica Teorica and ICTP, Trieste, Italy
   "Plasmons and Charge Density Waves in 2H-$TaSe_2$"
   January 26, 1978

10. Dr. J. M. Rowell, Bell Laboratories
    "Minimum Metallic Conductivity in Thin Films and Small Wires"
    February 9, 1978

11. Dr. N. P. Ong, Department of Physics, Univ. of Southern Calif.
"Anomalous Transport in a Charge Density Wave System: $NbSe_3$"
February 9, 1978

12. Dr. C. C. Tsuei, IBM, Yorktown Heights
"Comparison Between Amorphous and Crystalline Phases of Nb_3Ge"
January 18, 1978

13. Dr. A. Mahajan, Bell Laboratories
January 17, 1978

14. Dr. L. Falicov, Department of Physics, UC Berkely
"Two-Dimensional Physics in Semiconductors"
February 16, 1978

15. Dr. Lars Hedin, University of Lund, Sweden
"Many-Body Effects on Deep Level Spectra of Metals"
March 9, 1978

16. Dr. Daryl L. Smith, Department of Applied Physics, Caltech
"Bound Excitons in Silicon"
March 16, 1978

17. Dr. A. Phillips, Cavendish Laboratory, Cambridge University
"Interesting New Effect in Amorphous Arsenic"
April 6, 1978

18. Dr. A. Zunger, Department of Physics, UC California, Berkeley
"A First Principles One Electron Approach to Electronic Structure Problems in Solids"
April 20, 1978

19. Dr. J. A. Van Vechten, IBM Res. Center, Yorktown Heights, N.Y.
"Formation of Interstitial Type Dislocation Loops by Precipitation of Vacancies in Semiconductors"
May 18, 1978

20. Dr. Rene Flugiker, Department de Physique de la Matiere Condensee, Universite de Geneve, 1211 Geneve, Switzerland

21. Dr. Jean Rouxel, Laboratoire De Chimie Des Solides, France
September 5, 1978

22. Dr. Philip W. Anderson, Bell Laboratories
"The Concept of Localization"
February 21, 1978

23. Dr. John Hubbard, IBM, San Jose
"Theoretical Problems Associated with Organic Quasi-One Dimensional Conductors"
May 9, 1978

24. Dr. T. Fred Smith, Physics Department, Monash University Victoria, Australia
"Superconductivity and the Transition Metals"
October 4, 1978

25. Dr. Philip Platzman, Bell Laboratories
"The Electron Gas in Two-Dimensions"
October 19, 1978

26. Dr. J. Lawrence, University of California, Irvine, CA
"Scaling Behavior Near a Valence Instability"
November 2, 1978

27. Dr. J. Boyce, Xerox, Palo Alto Res. Ctr., Palo Alto, CA
"Recent Structural Studies of the Superionic Phase Transition"
November 16, 1978

28. Dr. J. G. Dash, University of Washington
"Questioning 2-D Superfluidity"
November 30, 1978

29. Dr. Paul Grant, IBM Research Center, San Jose, CA
"Electronic Properties of Polyacetylene $(CH)_x$"
January 4, 1979

30. Dr. J. E. Mooij, Delft University, The Netherlands
"Microwave-Stimulated Superconductivity"
Janury 11, 1979

31. Professor R. Kubo, University of Tokyo
"Theory of Low Field Spin Resonance Muon Depolatization"
January 26, 1979

32. Professor L. Kadanoff, University of Chicago, Illinois
"The Two-Dimensional Planar Model - An Old Problem Partially Solved"
February 1, 1979

33. Dr. C. Peter Flynn, University of Illinois, Illinois
"Charge Transfer and the Percolative Metal Insulator Transition"
February 15, 1979

34. Dr. Douglas Scalapino, University of California, Santa Barbara,
"Two Applied Problems in E & M: Cryogenic Microwave Switch and a Light Emitting Tunnel Junction"
March 1, 1979

35. Professor J. Rudnick, University of California, Santa Cruz
"The Profile of the Liquid Gas Interface Near a Critical Point"
March 8, 1979

36. Dr. J. J. Hauser, Bell Laboratories
"Amorphous MnSi - A Concentrated Spin Glass System"
March 15, 1979

37. Dr. Robert M. Westervelt, Department of Physics, UC Berkely
"Nucleation and Motion of Electron-Hole Drops in Germanium"
November 14, 1978

38. Dr. Arno A. Penzias, Director, Radio Research Laboratory
Bell Laboratires, 1978 Nobel Prize Laureate in Physics
"The Origin of the Elements"
February 6, 1979

39. Professor B. T. Matthias, Department of Physics, UC San Diego
"New Kinds of Superconductors and Magnets - and Old Ones"
February 13, 1979

40. Dr. Peter M. Eisenberger, Bell Laboratories
"EXAFS Structural Determinations - Successes and Failures"
February 10, 1979

41. Dr. R. Z. Bachrach, Xerox PARC
"Surface Structural and Electronic Properties of Overlayers on Semiconductors"
May 3, 1979

42. Dr. George Feher, Department of Physics, UC San Diego
"Noise Analyses (Fluctuation Spectroscopy) with Applications to Chemistry, Biology, and Physics"
May 8, 1979

43. Dr. J. Torrance, IBM Research Center, San Jose
"Phase Transition From a Neutral to an Ionic State of an Organic Solid"
October 4, 1979

44. Dr. Bertram Schwartz, Bell Laboratories
"The Gallium-Arsenic-Oxygen Equilibrium Phase Diagram"
October 19, 1979

45. Dr. Gerhard Siegl, IBM Research Laboratories
"Plasmon-Photon Modes of a Filamentary Lattice and Their Contribution to the Van-Der-Walls Energy"
November 1, 1979

46. Dr. R. Martin, Xerox Corporation, Palo Alto
"Metal-Insulator Transitions in Mixed Valence Systems"
November 8, 1979

47. Dr. H. Metiu, University of California, Santa Barbara
"Comments on the Theory of Enhanced Raman Scattering by Adsorbed Molecules"
November 15, 1979

48. Dr. G. R. Stewart, Los Alamos National Laboratory
"Impurity Stabilized A15 Niobium - A New Superconductor"
November 29, 1979

49. Dr. J. P. McTague, University of California, Los Angeles
"Melting in 2 Dimensions"
December 6, 1979

50. Dr. P. Pfeuty, Orsay and University of California, San Diego
"Antiferroelectric Phase Transition in Sodium - β Alumina"
December 13, 1979

51. Dr. J. C. Fuggle, Institut fur Festkorperforschung der KRA Julich, Germany
"Screening Incomplete Relaxation and Lifetime Effects In Photo-Electron and Auger Spectra"
January 8. 1980

52. Dr. G. D. Mahan, University of Indiana
"Polarizability of Ions in Crystals"
January 10, 1980

53. Dr. A. Schmid, Institute for Theoretical Physics, Santa Barbara
"Stability of Excited Superconducting States
January 17, 1980

54. Dr. William Johnson, California Institute of Technology
"Superconducting and Atomic Scale Structure of Metallic Glasses"
January 31, 1980

55. Dr. James W. Allen, Xerox Palo Alto Research Center
"Mixed-Valence Electronic States – Surface and Bulk"
February 14, 1980

56. Dr. Neil Bartlett, University of California, Berkeley
"New Synthetic Metals"
February 21, 1980

57. Dr. A. Thompson, Exxon Research Center
"Thermodynamics and Statistics of Lithium Intercalation in TiS_2"
April 17, 1980

58. Dr. A. Gossard, Bell Laboratories,
"Creation ϕ and Properties of Artificially Layered Semiconductor Compounds"
April 24, 1980

59. Dr. Guenter Ahlers, University of California, Santa Barbara
"Origin of Turbulence in a Fluid Heated From Below"
May 1, 1980

60. Dr. Bernardo Huberman, Xerox PARC, "Fluctuations and Chaos"
May 8, 1980

61. Sir Nevil F. Mott, Cambridge University
"An Overview of Amorphous Materials"
May 14, 1980

62. Professor J. Bevk, Harvard University
"Flux Pinning in Some Unconventional Superconductors"
May 22, 1980

63. Dr. D. Scalapino, University of California, Santa Barbara
"A Phenomenological Approach to Scaling For Adsorbed Lattice Gasses"
October 16, 1980

64. Dr. R. L. Greene, IBM Research Laboratory, San Jose
"Properties of the First Organic Superconductors"
November 6, 1980

65. Dr. H. Gutfreund, Hebrew University, Israel
"Organic Metals - A Unique Chapter in Solid State Physics"
November 13, 1980

66. Dr. C. M. Varma, Bell Laboratories, Murray Hill, NJ
"Interplay of Superconductivity and Magnetism"
November 20, 1980

67. Dr. Greg Stewart, Los Alamos Scientific Laboratory
"Specific Heat of a New High T_c Superconductor: Explosive Prepared A15 Nb_3Si"
November 24, 1980

68. Dr. A. D. Smith, University of California, Berkeley
"A New Thermoelectric Effect in Superconducting Tunnel Junctions"
January 8, 1981

69. Dr. Werner Hanke, Max Planck Instiut fur Feskotperforschung, Stuttgart, Germany
"Novel Aspects of Superconductivity in Inversion-Layer Systems"
January 15, 1981

70. Dr. G. Deutscher, Hebrew University, Israel
"Critical Currents and Critical Fields of Percolating Superconductors"
January 22, 1981

71. Dr. J. Gittleman, RCA and Stanford EE Dept.
"Transport and Optical Properties of Granular Metals"
February 5, 1981

72. Dr. S. G. Louie, University of California, Berkeley
"d-Electrons at Clean and Adsorbate-Covered Metal Surfaces"
February 19, 1981

73. Dr. Lu Yu, Institute for the Academic Sciences, Beijing, China
"Nonlinear Effects of Dynamics in Superfluid He Films"
February 26, 1981

74. Dr. R. H. Willens, Bell Laboratories, Murray Hill, NJ
"Compositionally Modulated Thin Metallic Films"
March 12, 1981

75. Dr. J. Knights, Xerox, Palo Alto, CA
"Microstructure and Inhomogeneity in Plasma Deposited Amorphous Semiconductors"
April 16, 1981

76. Dr. J. Ruvalds, Institute for Theoretical Physics, UC California, Santa Barbara and University of Virginia
"Resistance Minimum and Superconductivity in Layered Compounds"
May 7, 1981

77. Dr. Amnon Yariv, Department of Applied Physics, Caltech
"Integrated Opto Electronics"
May 19, 1981

78. Dr. P. Chaiken, University of California, Los Angeles
"Classical Wigner Cyrstals and Glasses in Charged Colloids"
May 28, 1981

79. Dr. H. Suhl, University of California, San Diego
"The Theory of Thermally Activated Processes Beyond the Brownian Motion Approximation"
June 4, 1981

80. Dr. P. Sheng, Exxon Research and Engineering
"Dielectric Function of Granular Metals"
June 8, 1981

81. Dr. D. Prober, Yale University
"Josephson Devices and Electron Localzi:ion in One Dimension: Recent Studies Near the Lim:ts of Microfabrication Science"
June 10, 1981

82. Dr. S. Nakajima, University of Tokyo
"Non Linear Oscillations of Superfluid ^{4}He Films"
August 13, 1981

83. Dr. K. Likharev, Moscow State University
"Real Macroscopic Quantum Effects in Josephson Junction"
September 2, 1981

84. Dr. K. Likharev, Moscow State University
"Theory of Superconducting Microbridges"
September 3, 1981

85. Dr. David S. McLachlan, IBM, Yorktown Heights, New York
"New Models for the Positive and Negative Temperature Coefficients of Resistivity for $TiO_{0.80-1.23}$ Metallic Oxides"
September 3, 1981

86. Dr. S. Alexander, Hebrew University and UCLA
"Superconductivity in Critical Fields on Random Networks"
October 1, 1981

87. Dr. Simon Moss, University of Houston
"X-ray Studies of Disorder and Phase Transitions in Layered Intercalates"
October 15, 1981

88. Dr. J. W. Allen, Xerox, Palo Alto, CA
"The Cerium Chronicles"
October 8, 1981

89. Dr. Stuart Wolf, U.S. Naval Research Laboratory & UCLA
"Superconductivity of Two-Dimensional Granular Niobium Nitride"
October 29, 1981

90. Dr. John Clarke, University of California, Berkeley
"Quantum Noise in Josephson Junctions and SQUIDS"
November 5, 1981

91. Dr. D. Scalapino, University of California, Santa Barbara
"Fermion Monte-Carlo Calculations - Pictures of the Ground State of a Many Electron System"
November 19, 1982

92. Dr. R. C. Dynes, Bell Laboratories
"Electron Localization and the Metal Insulator Transition"
December 3, 1981

93. Dr. Paul Horn, IBM, Yorktown Heights, New York
"In Search of the Holy Grail: The Melting of a Two-Dimensional Crystal"
December 10, 1981

94. Dr. L. M. Falicov, University of California, Berkeley
"Electronic, Chemical and Magnetic Properties of Metallic Overlayers"
February 25, 1982

95. Dr. C. C. Tsuei, IBM, Yorktown Heights, New York
"Flux Pinning Phenomena in Amorphous Superconductors"
March 4, 1982

96. Dr. T. F. Rosenbaum, Bell Laboratories, NJ
"Coulomb Interactions and Localization in a Disordered Metal"
March 17, 1982

97. Professor D. Haldane, University of Southern California
"Quantum Fluid State of One-Dimensional Systems"
April 15, 1982

98. Dr. R. B. Laughlin, Lawrence Livermore Laboratory
"Theory of the Quantum Hall Effect"
April 22, 1982

99. Dr. Stuart Parkin, IBM, San Jose
"Organic Superconductivity in the Linear Chain Compounds $[TMTSF]_2X$ and $[TMTTF]_2x$"
April 29, 1982

100. Professor E. Ben-Jacob, Institute for Theoretical Physics
UC Santa Barbara
"Chaos in Between Periodic States of a Josephson System"
May 6, 1982

101. Dr. M. Thompson, Xerox PARC
"Physics of Amorphous Silicon Devices"
May 13, 1982

102. Dr. J. Flouquet, C.E.R.N., Grenoble, & UC Berkeley
"TmSe and TmS Examples of 4f Instability Compounds"
May 20, 1982

103. Dr. P. M. Platzman, Bell Laboratories
"Is There Some Evidence for a Quantum Mechanical Phase Transition In 2-D Electron Gasses (MOS-GaAs)??!!
May 25, 1982

104. Professor P. Hohenberg, Institut for Theoretical Physics
UC, Santa Barbara
"Onset of Chaos"
May 27, 1982

105. Dr. J. C. Phillips, Bell Laboratories
"The Evolution of Order in Chaos - The Physics of Glass"
June 1, 1982

106. Dr. George Gruner, UC, Los Angeles
"Moving Charge Density Waves: A New Collective Transport Phenonmenon in Solids"
June 10, 1982

107. Dr. John Robertson, Cambridge, University & University of Illinois
"Defect Levels in $Si0_2$: Theory
June 10, 1982

108. Dr. John Carruthers, Hewlett-Packard Laboratories
"Materials Characterization of Silicon
July 26, 1982

VISITORS

1. Attendees of the Technical Advisory Committee for the Joint Service Electronics Program, February 1, 1978 Stanford University: Dr. Richard G. Brandt, and Dr. Jay Froman, Office of Naval Research

2. Dr. Subhash Mahajan, Bell Laboratories, January 22, 1979

3. Dr. John Rowell, Bell Laboratories, Feburary 7-8, 1979

4. Dr. R. C. Dynes, Bell Laboratories, February 8-9, 1979

5. Dr. Donald G. Naugle, Texas A&M University, February 12, 1979

6. Dr. E. L. Wolf, Dept. of Physics, Ames, Iowa, February 14, 1979

7. Dr. Don Stevens, Dept. of Energy, Washington, D.C. 2/15/79

8. Dr. Adam Heller, Bell Laboratories, February 19-21, 1979

9. Dr. Philip H. Abelson, Editor, Science Mag. Washington D.C. March 2, 1979

10. Campus visit of Dr. Else Kooi, Director, and Dr. Joze Kostelec, Deputy Director, North American Philips Research Laboratory, Sunnyvale, CA May 3, 1979

11. Dr. Serge Paidassi, Centre D'Etudes Nucleaires De. Grenoble, France May 4, 1979

12. Dr. Larry Kravitz, Air Force Office of Scientific Res. Washington, D.C. May 21, 1979

13. Dr. Lyle Schwartz, Northwestern Univ., Illinois, MRL Director May 21, 1979

14. Dr. R. Wasilewski, Materials Research Laboratory Section, National Science Foundation, Washington, D.C. MRL Director June 10, 1979

15. Dr. Ø. Fischer, Department de Physique de la Matiere Condensee Universite de Geneve, SWITZERLAND July 24, 1979

16. Dr. W. Schauer, Instiut fur Technische Physik, Kernforschungszentrum, Karlsruhe, Germany, August 17, 1979

17. Dr. H. C. Freyhardt, Institut fur Metallphysik der Universitat Gottingen, Hospitalstrasse 12, W. Germany August 31, 1979

18. Dr. Tatsumi Arakawa, Technical Research Laboratories Asahi Chemical Industry Co., Ltd. Japan September 4, 1979

19. Dr. Tom Walsh, Air Force Office of Scientific Res. Washington, D.C., October 2, 1979

20. Dr. Robert E. Schwall, Intermagnetics General Corporation November 12, 1979

21. Dr. Simon Foner, MIT, November 12, 1979

22. Dr. Christopher N. King, Tektronix, Inc., February 6, 1980

23. Dr. Paul Chu, University of Texas, Houston, February 8, 1980

24. Dr. John K. Hul, Westinghouse Research & Development February 21-23, 1980

25. Dr. Thomas E. Walsh, Mr. John E. Lintner and Ms. Kathy L. Wetherell, AFOSR, Washington, D.C. February 20-21, 1980

26. Dr. J. M. E. Harper, IBM Res. Ctr. Yorktown Heights, March 13, 1980

27. Dr. Ken McKay, Bell Laboratories, March 12, 1980

28. Dr. John Rowell, Bell Laboratories, March 12, 1980

29. Sir R. Peierls, Brookhaven National Laboratory February 28, 1980

30. Dr. Frank Di Salvo, Bell Laboratories, May 20, 1980

31. Dr. John Robertson, Cambridge University, May 24, 1980

32. Professor K. L. Ngai, NRL, Washington, D.C. July 21, 1980

33. Dr. Rosenburg, Dr. Al Green, & Victor Rehn, China Lake August 7, 1980

34. Dr. Pash K. Ummat, McMaster University, Canada, August 1980

35. Dr. Rudiger Borman, Institute fur Metallphysik Germany, August 1980

36. Dr. Zhao, Zong Xian, Institute of Physics, Chinese Academy of Sciences, China - September 1980

37. Professor John Rayne, Carnegie-Mellon, September 1980

38. Dr. John Hulm, Westinghouse Res. & Development September 1980

39. Dr. C. Tracy, General Motors, September 8, 1980

40. Dr. Al Clogston, Bell Laboratories, September 8-9, 1980

41. Professor Al Overhauser, Purdue University, September 11, 1980

42. Dr. R. Willis, ONR Washington, D.C., September 12, 1980

43. Professor H. Gutfreund, The Racah Institute of Physics The Hebrew University, October 21, 1980

44. Dr. Peter Mattern, Sandia Laboratory, October 22, 1980

45. Dr. W. Brinkman, Bell Laboratories, October 24, 1980

46. Dr. Frank Di Salvo, Bell Laboratories, November 3-5, 1980

47. Dr. Peter Kittel, NASA-AMES Res. Ctr. November 5, 1980

48. Dr. T. Gheewala, IBM, November 10, 1980

49. Dr. W. McLean, Rutgers University, December 15, 1980

50. Major Harry Winsor, AFOSR, January 23, 1981

51. Dr. Lou Nasonow, NSF, Washington D.C. January 23, 1981

52. Dr. R. M. Waterstrat, National Bureau of Standards Washington, D.C., February 2-10, 1981

53. Dr. F. Jamerson, GM Laboratory, February 5, 1981

54. Dr. D. Cromer, DOE, Washington, D.C., February 13, 1981

55. Dr. Chris King, Textronix, Veaverton, Oregon, February 25, 1981

56. Dr. Art Thompson, Exxon Res. Lab., February 26, 1981

57. Dr. Alex Braginski, Westinghouse Res. Lab., February 26, 1981

58. Dr. Jim Willis, Naval Air Systems Command, April 20, 1981

59. Dr. Victor Rehn, Naval Weapons Center, China Lake, CA
May 1, 1981

60. Dr. Ray Radebaugh, NBS, Boulder, CO May 5, 1981

61. Dr. K. Yamaya, Hokkaido University, Sapporo, Japan
August 5, 1981

62. Dr. Masayuki Ido, Hokkaido University, Sapporo, Japan
August 5, 1981

63. Professor H. Norden, Chalmers University of Techn. Sweden
August 5, 1981

64. Dr. R. Kuentzler, Universite Louis Pasteur, L.M.S.E.S., France
August 11, 1981

65. Dr. H. R. Ott, Laboratorium fur Festkorperphysik, Switzerland
August 17, 1981

66. Dr. H. C. Freyardt, Institut fur Metallphysik der Universitat
Gottingen, August 26, 1981

67. Dr. A. Clogston, Bell Laboratories, August 31, 1981

68. Dr. Hans Mooij, Technische Hogeschool Delft, The Netherlands
August 31, 1981

69. Dr. Larry Kravitz, AFOSR, October 27, 1981

70. Dr. Peter Kittel, NASA-AMES, Moffett Field, CA, October 27, 1981

71. Dr. C. N. King, Tektronix, Inc., November 12, 1981

72. Dr. B. Mattes, Dept. of Electrical Engineering, University
of Michigan, January 19, 1982

73. Dr. John Rowell, Bell Laboratories, February 10-11, 1982

74. Dr. S. Durbin, Dept. of Physics, Univ. of Illinois,
March 15, 1982

PERSONS WORKING ON CONTRACT DURING THE PERIOD 10/1/77 - 5/15/83

Hammond, R. H.	Senior Research Associate
Poon S. J.	Research Associate
Yamaya, K. Dept. of Nuclear Eng. Hokkaido University Sapporo, JAPAN	Visiting Scholar 12/1/77 - 3/26/79
Jacobson, B. Linkoping University SWEDEN	Visiting Senior Res. Associate 4/1/79 - 6/30/79
Smith, T. F. Monash University Clayton Victoria, Australia	Consultant
Collver, M. Universidade Estadual de Campinas Instituto De Fisica BRASIL	Visiting Senior Research Associate 4/1/79 - 6/30/79
Bormann, Rudiger Institute fur Metallphysik der Universitat Gottingen GERMANY	Visiting Research Associate
Yu, Ding Yi Shanghai University Shanghai, CHINA	Visiting Research Associate
Kimhi, D. B.	Ph.D. received July 1980 "Superconductivity and Tunneling Spectroscopy of Amorphous Transition Metals Mo and Nb"
Feldman, R. D.	Ph.D. received May 1981 "Electron Beam Evaporation of Superconducting, A15 Niobium-Silicon"
Kwo, J. R.	Ph.D. received June 1981 "Superconductivity of the A15 Compound Niobium Aluminum"

PERSONS WORKING ON CONTRACT (cont.)

Early, S. R.	Ph.D. received December 1981 "Small Sample Calorimetry at Low Temperatures"
Kihlstrom, K. E.	Ph.D. received August 1982 "Synthesis and Superconducting Properties of Niobium Germanium"
Talvacchio, J.	Ph.D. received August 1982 "Critical Currents in A15 Superconductors"
Carter, W.	Ph.D. received
Lowe, W.	Ph.D. received Dissertation in preparation
Celaschi, Sergio	Ph.D. expected Summer 1983
Hellman, F.	Ph.D. expected Spring 1984
Mael, D.	Ph.D. expected Spring 1984
Yoshizumi, Shozo	Ph.D. expected Spring 1984
Broussard, P.	Ph.D. expected Spring 1985
Park, T.	Ph.D. expected Spring 1985

Committees - T. H. Geballe

The National Research Council
Member of the National Assembly of Engineering

Department of Energy - Superconducting Steering Committee

Member of the Research Advisory Committee
to the Chemical Sciences Research Division
Westinghouse Research & Development Center

National Research Council - Assembly of Mathematical
& Physical Sciences

Solid State Sciences Committee and Advisory Panel

Ad Hoc Committee for NSF-MRL Directors

Associate Editor - Physical Review Letters

Member, Editorial Board of Chinese Physics, AIP

Reviewer at the Materials Sciences Program Review, Ames Laboratory
Iowa State University, May 7-8, 1980

Reviewer at the Materials Sciences Program Review, Ames Laboratory
Iowa State University, May 11-12, 1981

Member, Editorial Advisor for Physics and Chemistry of Materials
with Low-Dimensional Structures, D. Reidel Pub. Co.

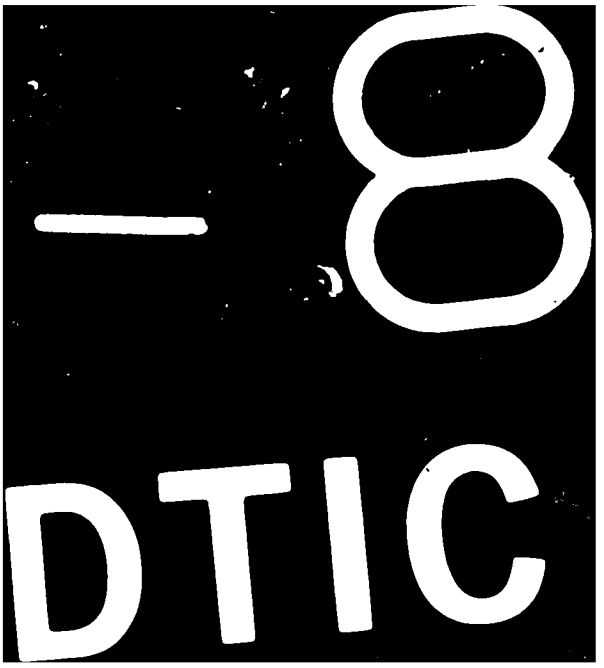
Advisory Panel, IV Conf. on Superconductivity in d- and f-Band
Metals, Kernforschungszentrum Karlruhe, Germany, June 23-26, 1982

Scientific projects are being carried out in close collaboration with industry

R. M. White, Xerox Corporation, Palo Alto, CA
R. L. Greene, IBM Research Laboratories, San Jose, CA
J. M. Rowell, Bell Laboratories, Murray Hill, NJ
J. H. Wernick, Bell Laboratories, Murray Hill, NJ
A. Braginski, Westinghouse Res. Lab, Pittsburgh, PA
P. Kittel, NASA-AMES, Moffett Field, CA
A. Green, and V. Rehn, Naval Res. Lab., China Lake,CA

New Discoveries, Invenstions or Patent Disclosures

1. Metallic Porous Membranes, by T. H. Geballe, W. L. Carter and R. G. Walmsley, August 1980 (Invention Disclosure)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